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Original article

Effect of cow manure and deficit irrigation with saline water on some morphological and biochemical characteristics of *Salicornia persica* Akhani

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Extended abstract

Introduction

Nowadays, in many parts of the world, especially in arid and semiarid regions, are facing with freshwater crisis and increasing the salinity levels of agricultural lands. Estimates show that over 800 million hectares of soil (more than six percent of the world's land) are affected by different levels of salinity. Therefore, it is important to find and cultivate high beneficial plants as well as highly resistant salinity and drought conditions. One of the salt-tolerant native species in Iran is salicornia persica. This plant falls into the canopodiaceae family and it can grow in saline and alkalis soils without suitable drainage. These features of salicornia cause not require agricultural land or agricultural water for growth. Salicornia oil is used in medicines (Traditional Medicine) to treat diseases such as bronchitis, liver swelling, diarrhea, hyperglycemia, anti-inflammation. Additionally, it has antioxidant properties that increase oil resistance to environmental conditions. Salt lands, unconventional waters such as drainage, saline or brackish water, and various climate in different parts of Iran have provided favorable conditions for this kind of cultivation. Therefore, the present study tries to discover some unknown points of morphological and biochemical responses of salicornia persica.

Materials and methods

To study some morphological and biochemical characteristics of salicornia persica under the application of cow manure and saline water deficit irrigation in a factorial completely randomized design was conducted in 2018 with three replicates under greenhouse conditions at the Agricultural and Natural Resources Research Station of Zahak (In Sistan and Baluchestan Province). Irrigation treatments included full irrigation with saline water (SI) as control, deficit irrigation with saline water under 75% level [(DSI75) 25% decrease compared to control] and deficit irrigation with saline water under 55% level [(DSI55) there was a 45% decrease compared to control]. A couple of traits such as fresh and dry root weight, dry biomass, catalase and guaiacol peroxidase, Ionic leakage, photosynthetic pigments, carbohydrate, protein, and proline were measured. In order to measure the proline content of leaves by the Bates method (Bates, 1973), Carbon hydrate content was determined by Schlegel (1956).To measure Catalase Enzyme Activity (CAT) by method Beers and Sizer (1952) And guaiacol peroxidase (GPX) were used by a method (Urbanek et al., 1991). Analysis of variance was performed using SAS statistical software version 9.1. Mean comparisons at the 5% probability level were performed using Duncan's multiple range test and charting with Excel.

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Results

The results showed a significant difference between the effects of cow manure, drought stress and interaction between them on most of the studied traits. By comparing the means, fresh and dry weights of root and protein respectively with means (1.647, 0.553, 9.47) were the highest The amount in the application of manure. and among the irrigation levels of fresh and dry root weights respectively with means (2.170, 0.595) at medium stress SI (DSI75) and chlorophyll b, carotenoid, carbohydrate, and protein, respectively with mean (0.138, 0.087, 9.07, 11.47) at intensive stress (DSI55) Showed the highest value. Also application of manure increased significantly the amount of biomass and catalase enzyme.

Conclusion

Compare to full irrigation, although a 25% reduction in saline water consumption leads to enhance of photosynthetic pigments and osmotic regulators, reduction of biomass under severe drought conditions, it seems that salicornia persica can tolerate Somewhat Drought stress, it is not highly tolerated to drought under intensive stress. So that this plant halophyte tolerates high salinity easily. The results also showed that the application of manure almost Most of the studied traits were reduced.

Keywords: Biomass, Organic fertilizer, Persica, Proline, Salinity

Table 1. Physical and chemical characteristics of soil experimental

Clay	Silt	Sand	Soil texture	EC†	pH†	Na‡	Ca‡	Mg‡	SAR
----------%----------				$dS\ m^{-1}$		----------meq L^{-1}----------			meq/$L^{0.5}$
37	23	40	Clay loam	8.3	8.4	62.3	356	1310	2.2

†Obtained from soil saturated extract. ‡Were calculated in solution.

Table 2. The chemical characteristics of applied cow manure

(1:5) EC	SAR*	pH	Na^+	Ca^{2+}	Mg^{2+}	K^+
$dS\ m^{-1}$	$1/(meq/L)^{-0.5}$		---------- meq L^{-1} ----------			
5.1	7.8	7.5	92.2	139	126	41.3

* sodium absorption ratio

Table 3. Quality of irrigation water (saline water) used in the present study

EC	pH	SAR	Na^+	Ca^{2+}	Mg^{2+}	K^+	HCO_3^-	Cl^-	$SO4^{2-}$
$dS\ m^{-1}$		meq/$L^{0.5}$	----------meq L^{-1}----------						
7.2	7.6	8.3	30.8	13.1	14.2	0.23	9.1	31.2	23.9

Table 4. Analysis of variance of morphological and biochemical characteristics of Salicornia under drought stress and cow manure

S.O.V	DF	Root Fresh weight	Root dry weight	Dry matter	Chlorophyll a	Chlorophyllb	Carotenoids
Manure (M)	1	0.023**	0.022**	0.0496**	0.000057 ns	0.000249 ns	0.000040 ns
Drought stress (D)	2	0.057**	0.056**	0.0762**	0.00822**	0.00204**	0.00100**
D * M	2	0.002 ns	0.0019ns	0.0015**	0.000866**	0.000012 ns	0.000056 ns
Error	12	0.002	0.002	0.00037	0.00010	0.0000805	0.000023
CV%	-	*9.21*	*9.206*	*5.317*	*5.334*	*7.420*	*6.315*

Table 4. Continued

S.O.V	df	Proline	Carbohydrate	Protein	Catalase	Gaiacol Peroxidase	Ionic leakage
Manure (M)	1	0.00217**	1.363 ns	5.013*	0.018**	0.551**	10/967**
Drought stress (D)	2	0.00639**	15.077**	48.406**	0.037**	0.186**	32/527**
D * M	2	0.000572**	0.063 ns	0.037 ns	0.101**	0.374**	20/903**
Error	12	0.000032	0.389	0.865	0.000	0.001	0/085
CV%	-	4.905	8.199	10.09	3.72	4.54	5/72

*, ** Statistically significant at the probability levels of 5% and 1%, respectively. ns: non- significant

Table 5. Comparison of averages of some morphological and biochemical characteristics of salicornia under drought stress and cow manure

Treatments	Root fresh weight	Root dry weight	Clorophyll b	Carotenoid	Carbohydrat	Protein
	-------g.plant^{-1}----------		----------mg.g^{-1}----------			
Manure						
No application	1.310^{b}	0.482^{b}	0.124^{a}	0.078^{a}	7.33^{b}	8.69^{b}
application	1.647^{a}	0.553^{a}	0.11 7^{b}	0.075^{b}	7.88^{a}	9.74^{a}
Irrigation levels						
Control (SI)	1.485^{b}	0.550^{a}	0.101^{c}	0.062^{b}	5.92^{c}	6.02^{c}
Medium stress (DSI75)	2.170^{a}	0.595^{a}	0.123^{b}	0.081^{a}	7.83^{b}	10.15^{b}
Sever stress (DSI55)	0.780^{c}	0.408^{b}	0.138^{a}	0.087^{a}	9.07^{a}	11.47^{a}

Means in each column followed by the similar letter are not significantly different at 5% probability level. Irrigation with saline water: (SI) control. (DSI75) medium stress. (DSI55) intensive stress. Manure; without Application of manure. Application of manure

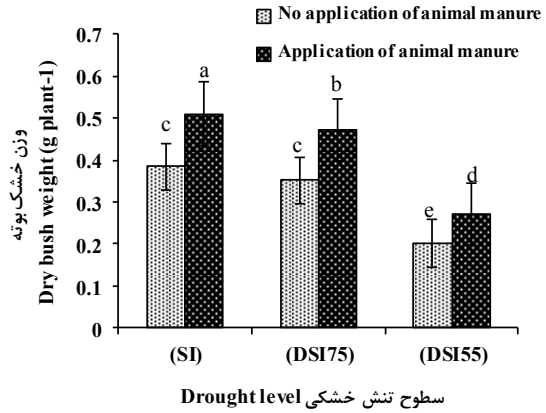

Fig 1. Interaction effect of drought stress and manure on dry weight (g plant^{-1}) of salicorni. Means followed by the similar letter are not significantly different at 5% probability level. Full irrigation with saline water (SI) as a control, deficit irrigation with saline water under 75% level (DSI75) and deficit irrigation with saline water under 55% level (DSI55).

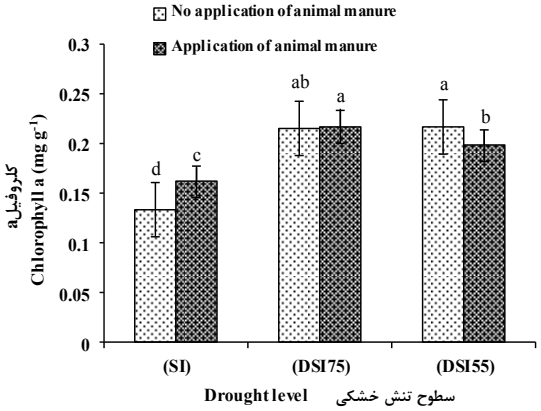

Fig. 2. Interaction effect of drought stress and manure on Chlorophyll a (mg g^{-1}) in salicornia. Means followed by the similar letter are not significantly different at 5% probability level. Full irrigation with saline water (SI) as a control, deficit irrigation with saline water under 75% level (DSI75) and deficit irrigation with saline water under 55% level [(DSI55).

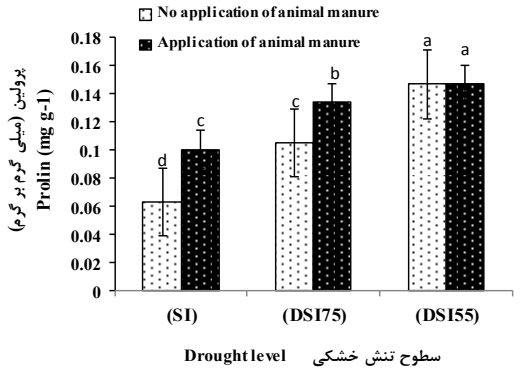

Fig 3. Interaction effect of drought stress and manure on proline (mg g^{-1}) in salicornia. Means in each column followed by the similar letter are not significantly different at 5% probability level. Full irrigation with saline water (SI) as a control, deficit irrigation with saline water under 75% level [(DSI75) 25% decrease compared to control] and deficit irrigation with saline water under 55% level [(DSI55) there was a 45% decrease compared to control].

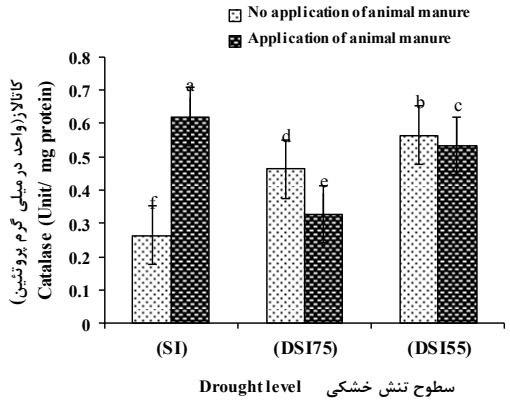

Fig 4. Interaction effect of drought stress and manure on catalas (Unit/ mg proteine) in salicornia. Means in each column followed by the similar letter are not significantly different at 5% probability level. Full irrigation with saline water (SI) as a control, deficit irrigation with saline water under 75% level [(DSI75) 25% decrease compared to control] and deficit irrigation with saline water under 55% level [(DSI55) there was a 45% decrease compared to control].

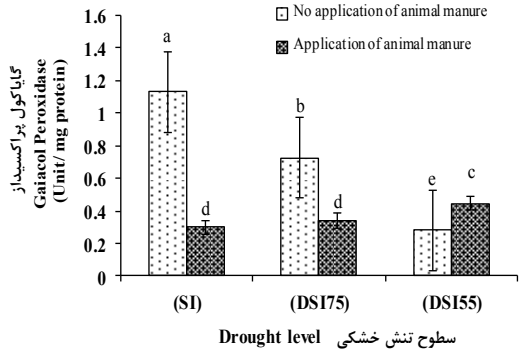

Figure 5. Interaction effect of drought stress and manure on gaiacol peroxidase (Unit/ mg proteine) in salicornia. Means in each column followed by the similar letter are not significantly different at 5% probability level. Full irrigation with saline water (SI) as a control, deficit irrigation with saline water under 75% level [(DSI75) 25% decrease compared to control] and deficit irrigation with saline water under 55% level [(DSI55) there was a 45% decrease compared to control].

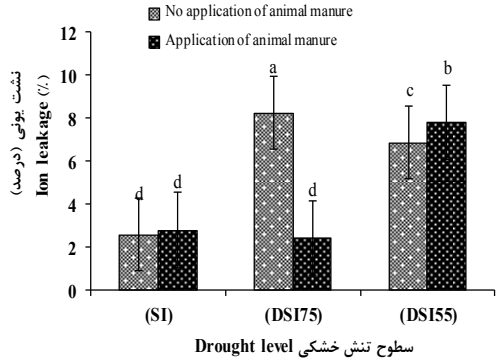

Fig. 6. Interaction effect of drought stress and manure on ionic leakage (%) in salicornia. Means in each column followed by the similar letter are not significantly different at 5% probability level. Full irrigation with saline water (SI) as a control, deficit irrigation with saline water under 75% level [(DSI75) 25% decrease compared to control] and deficit irrigation with saline water under 55% level [(DSI55) there was a 45% decrease compared to control].